TRANSLATION

I, Yuko Mitsui, residing at 4-6-10, Higashikoigakubo, Kokubunji-shi, Tokyo, Japan, state:

that I know well both the Japanese and English languages,

that I translated, from Japanese into English, Japanese Patent Application No. 11-285139, filed on October 6, 1999, and

that the attached English translation is a true and accurate translation to the best of my knowledge and belief.

Dated: January 22, 2004

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Applicant(s): TOKYO ELECTRON LIMITED

This 14th day of July 2000

Commissioner,
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Kozo Oikawa (seal)

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[Title of the Invention] PROBING METHOD AND PROVING APPARATUS

[What is claimed is:]

[Claim 1] A probing method which, under the control of a controller, brings an object of inspection on a main chuck that is movable in X-, Y-, Z and θ-directions, into contact with probes of a probe card, and overdrives the main chuck to inspect electrical properties of the object of inspection, characterized by comprising: under the control of the controller, measuring, by means of a pressure sensor provided with the main chuck, a load generated by contact of the probes with the object of inspection during overdrive operation; and controlling an overdrive of the main chuck on the basis of the measured load.

[Claim 2] The probing method according to claim 1, characterized by comprising: obtaining a distortion of the main chuck with respect to the measured load on the basis of the relation between the load applied to the main chuck and the distortion; and correcting dislocations between the probes and the object of inspection in accordance with the distortion.

[Claim 3] A probing method which, under the control of a controller, brings an object of inspection on a main chuck that is movable in X-, Y-, Z and θ-directions, into contact with probes of a probe card, and overdrives the main chuck to inspect electrical properties of the object of inspection, characterized by comprising: under the control of the controller, locating, right under the probes, a polish plate

of a polishing mechanism attached to the main chuck, which is used when the tip of the probes is polished; measuring by a pressure sensor attached to the polishing mechanism, a load generated by contact of the polish plate with the probes when the polish plate is overdriven in the location; and controlling an overdrive of the main chuck on the basis of the measured load.

[Claim 4] The probing method according claim 3, characterized by comprising: after obtaining a distortion of the polishing mechanism with respect to the measured load on the basis of the measured load and the relation between the load and the distortion of the polishing mechanism, obtaining a spring constant of the probes from the distortion and an overdrive of the polish plate; obtaining the load generated on the main chuck in accordance with the relation between a spring constant of the main chuck obtained in accordance with the spring constant and the relation between the load applied to the main chuck and the distortion, and the overdrive of the main chuck; and controlling the overdrive of the main chuck on the basis of the generated load.

[Claim 5] A probing apparatus provided with: a main chuck carrying an object of inspection thereon; a probe card located over the main chuck; a drive mechanism for moving the main chuck in X-, Y-, and Z-directions to bring the probes of the probe card into contact with the object of inspection; and a controller for controlling the drive mechanism, and under the control of the controller, after moving the main chuck to bring the object of inspection into contact with the probes,

overdriving the main chuck to inspect electrical properties of the object of inspection, the apparatus characterized in that the main chuck comprises a pressure sensor which measures a contact load between the object of inspection and the probes, and the controller comprises means for obtaining a distortion of the main chuck in accordance with a position where the probes contacts the object of inspection and the load measured by means of the pressure sensor in the position.

[Claim 6] A probing apparatus provided with: a main chuck carrying an object of inspection thereon; a probe card located over the main chuck; a drive mechanism for moving the main chuck in X-, Y-, and Z-direction to bring the probes of the probe card into contact with the object of inspection; a controller for controlling the drive mechanism; and a polishing mechanism which is attached to the main chuck and polishes the probes, and under the control of the controller, after moving the main chuck to bring the object of inspection into contact with the probes, overdriving the main chuck to inspect electrical properties of the object of inspection, the apparatus characterized in that the polishing mechanism comprises: a polish plate which polishes the probes; and a pressure sensor which measures a contact load between the polish plate and the probes, and the controller comprises: means for obtaining a spring constant of the probes in accordance with the load measured by the pressure sensor; means for obtaining a spring constant on the main chuck in accordance with the relation between the load and distortion of the main chuck; and means for obtaining a load generated on

the position where the probes contacts the main chuck in accordance with the relation between the respective spring constants of the probes and the main chuck and an overdrive of the main chuck.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a probing method and a probing apparatus, and more specifically, to a probing method and a probing apparatus, which can measure a contact load of probes in overdrive operation, obtaining a steady contact load, which secures inspection with high reliability.

[0002]

[Prior Art]

As shown, for example in FIG. 8, a probing apparatus 10 is provided with a loading chamber 11 which delivers wafers W stored in a cassette C one after another and transports the wafers, a probing chamber 12 which adjoins the loading chamber 11 and inspects the wafers transported from the loading chamber 11, a controller 13 which controls the probing chamber 12 and loading chamber 11, and a display unit 14 which doubles as a control panel for operating the controller 13.

[0003]

The loading chamber 11 is provided with a pair of tweezers 15 for use as a transportation mechanism for the wafers W on a rotating shaft. The tweezers 15 moves back and forth in the horizontal direction and rotates forward and reversely, thereby delivering the wafers W in the cassette C

one after another and transporting them into the probing chamber 12. A sub-chuck 16 for pre-aligning each wafer W is provided near the tweezers 15. As the sub-chuck 16 receives each wafer W from the tweezers 15 and rotates forward or reversely in a θ-direction, it detects optically the orientation flat of the wafer W, to pre-align the wafer W on the basis of the detected orientation flat.

[0004]

The probing chamber 12 adjacent to the load chamber 11 is provided with a main chuck 17 that carries each wafer W thereon. The main chuck 17 is moved in X- and Y-directions by means of X- and Y-stages 18, 19, respectively, and moved in Z- and θ-directions by means of built-in drive mechanisms. Alignment means 20 is provided in the probing chamber 12. The alignment means 20 aligns each wafer W. The alignment means 20 includes an alignment bridge 22 having first image-pickup means 21 formed of CCD camera for imaging the wafer W, a pair of guide rails 23, 23 for guiding the bridge 22 in reciprocation in the Y-direction, and second image-pickup means (not shown) formed of CCD camera attached to the main chuck 17. A probe card (not shown) is provided on the top surface of the probing chamber 12. To the upper surface of the probe card, a test head is connected electrically by means of a connecting ring (not shown). The probe card receives a test signal from a tester via the test head and the connecting ring, and performs inspection of electrical properties of the wafer W, which contacts the probes.

[0005]

In inspecting each wafer W, the tweezers 15 in the loading chamber 11 takes out one of the wafers W from the cassette C. While the wafer W is being transported to the probing chamber 12 by the tweezers 15, it is pre-aligned on the sub-chuck 16. Thereafter, the tweezers 15 delivers the wafer W to the main chuck 17 in the probing chamber 12. The alignment bridge 22 moves to the center of the probe card and moves to the position under the first image-pickup means 21 thereof, and the first image-pickup means 21 cooperates with the second image-pickup means on the main chuck 17 side, in aligning the wafer on the chuck 17. As the main chuck 17 moves in the X- and Y-directions, the wafer W is subjected to index feed. As the chuck 17 ascends in the Z-direction, bringing the wafer W into contact with the probes, the main chuck 17 is overdriven, to bring IC chips on the wafer W into electrical contact with the probes, thereby inspecting electrical properties of the chips.

[0006]

In the case of a wafer W with a diameter of, for instance, 200 mm or less, as shown in FIG. 9(a), the wafer W on the main chuck 17 ascends from the position indicated by dashed line to the position indicated by full line as the main chuck 17 is overdriven. As indicated by full line in FIG. 9(a), the wafer W rises in the Z-direction without substantially tilting from its horizontal position. As this is done, each probe 24A of a probe card 24 is elastically raised from the position of dashed line to the position of

full line of FIG. 9(a). The tip of the probe 24A moves from a starting point S to an ending point E, as indicated by thick line. The plane distance covered by the tip that moves from the starting point S to the ending point E, as indicated by hatched arrow in FIG. 9(b), is within the area of an electrode pad P of each IC chip. Thus, the probe 24A and the electrode pad P are brought electrically into contact with each other, whereupon the IC chip is inspected.

[0007]

In the case of a wafer W with a diameter of 300 mm, the wafer size is too large, and besides, the IC chips are hyperfine, and electrode pads are arranged at narrow pitches. Correspondingly, the number of pins of the probe card is increased, for example, to 2000. In this case, a load from the total probes 24A that acts on the main chuck 17 when the chuck is overdriven is as heavy as, for example, 10 kg to 20 kg. Accordingly, an unbalanced load that is generated when the wafer W is overdriven from the position indicated by dashed line in FIG. 10(a) so that it touches the probes 24A causes the rotating shaft (not shown) of the main chuck 17 to bend. In consequence, for example, the wafer W is tilted for about 20 to 30 μm, as indicated by full line in FIG. 10(a), and deflected outward from its original raised position. As this is done, the tip of each probe 24A is elastically raised from the position indicated by dashed line to the position indicated by full line of FIG. 10(a), and moves along a track (indicated by thick line in FIG. 10(a)) that is longer than the one shown in FIG. 9(a). Although the

starting point S of the tip is situated in the same position as the one shown in FIG. 9(a), the ending point E is located outside the area of the electrode pad P, as indicated by hatched arrow in FIG. 10(b). Thus, the tip may come off the electrode pad P during inspection operation. As a result, test signals cannot be transmitted from the probes 24A to the electrode pads P, so that the reliability of the inspection is lowered.

[0008]

In Jpn. Pat. Appln. KOKAI Publication No. 9-306516, the inventor hereof proposed a probing method and a probing apparatus in which dislocation of probes attributable to contact load is corrected three-dimensionally. According to this technique, the probes estimate a distortion of a main chuck in the position where the probes are in contact with a wafer, in accordance with known data, such as information (outside diameter, material, etc.) on the main chuck, information (outside diameter, number of chips, etc.) on the wafer, and information (probe tip area, number of probes, etc.) on a probe card. Based on the estimated value, the position where the probes are in contact with the wafer is corrected three-dimensionally.

[0009]

[Object of the Invention]

According to the probing method and the probing apparatus proposed in Jpn. Pat. Appln. KOKAI Publication No. 9-306516, in three-dimensional correction of the contact position of the probes, a load (needle pressure) applied to the contact

position is estimated in accordance with the contact position of the probe 24A for overdrive operation and a given overdrive, and the distortion of the main chuck 17 is estimated according to the estimated load. Therefore, the consistency of the estimated load and an actual load in contact is not secured, therefore, the three-dimensional correction of the contact position of the probes may possibly be wrong. Further, conventionally, the given overdrive is obtained based on driving level of the Z-axis. Therefore, even if the distance between the probe tip and the wafer W changes due to deformation of the probe card 24 with time or thermal expansion or contraction of the card during inspection, since the overdrive of the main chuck 17 is fixed, a constant contact load cannot be obtained.

[0010]

The present invention has been made to solve the above problems, and it is therefore an object of the invention to provide a probing method and probing apparatus, which brings probes and electrode pads of an object of inspection accurately into contact with one another under a steady load even if a probe card is deformed from various causes or expanded or contracted by any thermal effect, and in which probes and electrode pads of an object of inspection can be brought accurately into contact with one another even if a main chuck is tilted by an unbalanced load during overdrive operation, so that high-accuracy inspection can be enjoyed.

[0011]

[Means for Achieving the Object]

With respect to the present invention described in claim 1, there is provided a probing method which, under the control of a controller, brings an object of inspection on a main chuck that is movable in X-, Y-, Z and θ-directions, into contact with probes of a probe card, and overdrives the main chuck to inspect electrical properties of the object of inspection. The probing method is characterized by comprising: under the control of the controller, measuring, by means of a pressure sensor provided with the main chuck, a load generated by contact of the probes with the object of inspection during overdrive operation; and controlling an overdrive of the main chuck on the basis of the measured load.

[0012]

With respect to the present invention described in claim 2, there is provided the probing method according to claim 1. The method is characterized by comprising: obtaining a distortion of the main chuck with respect to the measured load on the basis of the relation between the load applied to the main chuck and the distortion; and correcting dislocations between the probes and the object of inspection in accordance with the distortion.

[0013]

With respect to the present invention described in claim 3, there is provided a probing method which, under the control of a controller, brings an object of inspection on a main

chuck that is movable in X-, Y-, Z and θ-directions, into contact with probes of a probe card, and overdrives the main chuck to inspect electrical properties of the object of inspection. The probing method is characterized by comprising: under the control of the controller, locating, right under the probes, a polish plate of a polishing mechanism attached to the main chuck, which is used when the tip of the probes is polished; measuring by a pressure sensor attached to the polishing mechanism, a load generated by contact of the polish plate with the probes when the polish plate is overdriven in the location; and controlling an overdrive of the main chuck on the basis of the measured load.

[0014]

With respect to the present invention described in claim 4, there is provided the probing method according claim 3. The probing method is characterized by comprising: after obtaining a distortion of the polishing mechanism with respect to the measured load on the basis of the measured load and the relation between the load and the distortion of the polishing mechanism, obtaining a spring constant of the probes from the distortion and an overdrive of the polish plate; obtaining the load generated on the main chuck in accordance with the relation between a spring constant of the main chuck obtained in accordance with the spring constant and the relation between the load applied to the main chuck and the distortion, and the overdrive of the main chuck; and controlling the overdrive of the main chuck on the basis of the generated

load.

[0015]

With respect to the present invention described in claim 5, there is provided a probing apparatus provided with: a main chuck carrying an object of inspection thereon; a probe card located over the main chuck; a drive mechanism for moving the main chuck in X-, Y-, and Z-directions to bring the probes of the probe card into contact with the object of inspection; and a controller for controlling the drive mechanism, and under the control of the controller, after moving the main chuck to bring the object of inspection into contact with the probes, overdriving the main chuck to inspect electrical properties of the object of inspection. The apparatus is characterized in that the main chuck comprises a pressure sensor which measures a contact load between the object of inspection and the probes, and the controller comprises means for obtaining a distortion of the main chuck in accordance with a position where the probes contacts the object of inspection and the load measured by means of the pressure sensor in the position.

[0016]

With respect to the present invention described in claim 6, there is provided a probing apparatus provided with: a main chuck carrying an object of inspection thereon; a probe card located over the main chuck; a drive mechanism for moving the main chuck in X-, Y-, and Z-direction to bring the probes of the probe card into contact with the object of inspection; a controller for controlling the drive mechanism; and a polishing mechanism which is attached to the main chuck and

polishes the probes, and under the control of the controller, after moving the main chuck to bring the object of inspection into contact with the probes, overdriving the main chuck to inspect electrical properties of the object of inspection. The apparatus is characterized in that the polishing mechanism comprises: a polish plate which polishes the probes; and a pressure sensor which measures a contact load between the polish plate and the probes, and the controller comprises: means for obtaining a spring constant of the probes in accordance with the load measured by the pressure sensor; means for obtaining a spring constant on the main chuck in accordance with the relation between the load and distortion of the main chuck; and means for obtaining a load generated on the position where the probes contacts the main chuck in accordance with the relation between the respective spring constants of the probes and the main chuck and an overdrive of the main chuck.

[0017]

[Embodiments of the Invention]

The invention will be described in connection with embodiments shown in FIGS. 1 to 7, in which like reference numerals refer to like or equivalent portions throughout the several views.

A probing apparatus 10 according to an embodiment of the invention, like the probing apparatus shown in FIG. 8, may be provided with a loading chamber 11 and a probing chamber 12. The tweezers 15 and a sub-chuck 16 are arranged in the loading chamber 11. Wafers W in a cassette C are transported one

after another by means of the tweezers 15. In this process of transportation, each wafer W can be pre-aligned by means of the sub-chuck 16. A main chuck 17, which is movable in Z- and θ-directions, X-stage 18, Y-stage 19, and alignment means 20 are arranged in the probing chamber 12. As the main chuck 17 moves in X-, Y-, Z-, and θ-directions under the control of a controller 13, it aligns the wafer W thereon in conjunction with the alignment means 20. After the alignment, the wafer W is checked for electrical properties by means of the probe card (not shown).

[0018]

According to the present embodiment, a pressure sensor 31 such as load cell is provided between the main chuck 17 and the X-table 18 in the arrangement shown in FIG. 1 and is used to measure load from the probe 24A that acts on the wafer W on the main chuck 17. As shown in FIG. 2, the sensor 31 is connected to the controller 13. The controller serves to control the needle pressure of the probe 24A to be constant on the basis of the signal measured by the pressure sensor 31.

[0019]

As shown in FIG. 2, the controller 13 comprises first storage means 131 for storing data such as wafer information on the wafers W, card information on the probe card, etc., second storage means 132 for storing data such as control programs for the probing apparatus, main chuck information on the main chuck 17, and a central processing unit (hereinafter referred to as "CPU") 133 which reads the individual pieces of information stored in the first and second storage means 131

and 132 and carry out processes based on predetermined programs.

[0020]

The wafer information includes parameters such as the location of each chip, chip size, position of the center of gravity of the chip, number of electrode pads, area of the electrode pads, pitches between the electrode pads, etc. The card information may include parameters such as the number of probe needles (number of pins), location of the probe needles, material and properties of the probe needles, etc. The main chuck information may include parameters such as the mechanical strength of the rotating shaft of the main chuck 17, outside diameter and load-distortion data of the chuck 17, etc. The load-distortion data may be defined as data that are indicative of load on a typical point on the upper surface of main chuck 17 and the relation between the load and the distortion of the chuck 17.

[0021]

The CPU 133 includes the measured load (needle pressure) of the pressure sensor 31 and distortion processing means 133A which obtains the distortion of the main chuck 17 for a probe contact position in an overdrive mode in accordance with the load-distortion data of the main chuck by the second storage means 132 and the wafer information. The distortion processing means 133A is used to obtain the distortion of the main chuck 17 in accordance with the measured load of the pressure sensor 31 for the contact position of the probe 24A and the load-distortion data.

[0022]

As shown in FIG. 2, input means (e.g., keyboard, etc.) 25 and the display unit 14 are connected to the controller 13. Necessary data for various inspections, such as the wafer information and main chuck information, are input by means of the input means 25. The input data are recognized by the display unit 14. A drive mechanism 26 is connected to the controller 13. The drive mechanism 26 serves to drive the main chuck 17.

[0023]

The following is a description of the probing method and the operation of the probing apparatus according to the present embodiment. Before the wafers W are inspected, the wafer information and the card information are input by the input means 25. The input data are recognized on a display screen. If the input data are correct, they are registered and stored in the first storage means 131. The wafers W in each cassette are fed into the probing apparatus 10. Upon activation of the probing apparatus 10, each wafer W pre-aligned in the loading chamber is fed onto the main chuck 17 in the probing chamber. In the probing chamber, the wafer W is aligned by means of the alignment means. Subsequently, the electrical properties of each chip of the wafer W are successively inspected.

[0024]

In the inspection of each chip, the CPU 133 reads programs for the probing method of the present invention from the second storage means 132, and the probing apparatus 10 is

actuated in accordance with programs. In other words, the first one of the chips on the wafer W to be inspected is settled. The CPU 133 subjects the main chuck 17 to index feed, whereupon the chips on the wafer W are inspected in succession. In the inspection of each chip, the main chuck 17 is overdriven after it ascends to a position where the wafer W and the probe 24A are in contact with each other. During the overdrive operation, the pressure sensor 31 is actuated to measures load (needle pressure) between the probe 24A and the wafer W. The overdrive is monitored in accordance with the measured load. When a preset load value is measured by means of the pressure sensor 31, the controller 13 stops the operation of the drive mechanism 26, thereby stopping the main chuck 17, whereupon a fixed overdrive can be secured. The main chuck 17 tilts as it is subjected to an unbalanced load during the overdrive operation, as is exaggeratingly indicated in FIG. 3. Incidentally, in FIG. 3, the deformation of the probe card 24 is exaggeratingly illustrated, where arrows indicate a contact load and its reaction force, individually.

[0025]

In the conventional probing method, the overdrive is controlled by fixing the ascent of the main chuck 17 in the Z-direction. Accordingly, the position of the tip of the probe 24A is vertically deviated from its reference position, due to thermal expansion of the probe card 24 that is caused when the wafer W is heated during the inspection, contraction of the card 24 that is caused when the wafer W is cooled, or deformation of the card 24 with time, as illustrated

exaggeratingly in FIG. 3. Besides, as the conventional probing method, the ascent of the main chuck 17 in the Z-direction is controlled, an overdrive that matches the actual distance between the probe 24 and the wafer W cannot be secured. In consequence, the contact load and the tip position fluctuate depending on the spot of contact of the probe, so that it is hard to effect steady inspection. However, according to the present embodiment, the pressure sensor measures the contact load (needle pressure) between the probe 24A and the wafer W. Since the overdrive is controlled according to this measured load, steady inspection can be carried out under a constant contact load (needle pressure) without being influenced by any thermal effect or deformation of the probe card 24 with time.

[0026]

According to the present embodiment, the contact position of the probe 24A can be corrected three-dimensionally during the overdrive operation. The method of the present embodiment, unlike a probing method proposed in Jpn. Pat. Appln. KOKAI Publication No. 9-306516, can three-dimensionally correct the contact position of the probe 24A in accordance with the measured load from the probe 24A and the wafer W, which acts on the main chuck 17. According to the method described in Jpn. Pat. Appln. KOKAI Publication No. 9-306516, the contact load produced by the probe is estimated on the basis of the overdrive, distortion of the main chuck 17 is obtained from the estimated value, and then the contact position of the probe 24A is three-dimensionally corrected in

accordance with the distortion.

[0027]

As the wafer W, which is in contact with the probe 24A in the position indicated by dashed line in FIG. 4, is overdriven to the position indicated by full line, it is subjected to an unbalanced load from the probe 24A, and the main chuck 17 is tilted by the unbalanced load. In consequence, the wafer W tilts outward from its original position, and the starting point S of the tip of the probe 24A is urged to move in the direction indicated by arrow A in FIG. 4. However, according to the present embodiment, in the controller 13, the distortion processing means 133A obtains distortion for the load measured by means of the pressure sensor 31, in accordance with the measured load and the load-distortion data. Based on this distortion, the movement of the main chuck 17 is corrected by means of the drive mechanism 26, and the wafer W moves in the direction of arrow B in FIG. 4. Thus, the moving direction of the main chuck 17 is corrected according to the load measured by means of the pressure sensor 31. Accordingly, the wafer W ascends as if it were kept horizontal, and the tip of the probe 24A is vertically lifted upward, as indicated by arrow C. In consequence, as illustrated by thick line in FIG. 5(a), the probe tip moves on a track that is hardly different from the track for the case where the wafer W is lifted horizontally (see FIG. 9). As shown in FIG. 5(b), an ending point E of the tip remains in an electrode pad P at the ascending end of the main chuck 17. In consequence, the probe 24A comes securely into contact with

the given electrode pad P, so that the inspection of the chips can be carried out securely and steadily.

[0028]

According to the present embodiment, as described above, the load that is produced as the probe 24A touches the wafer W is measured by means of the pressure sensor 31 when the main chuck 17 is overdriven under the control of the controller 13, and the overdrive of the main chuck 17 is controlled according to the measured load. Therefore, if the probe card 24 is deformed by any thermal effect or use, the probe 24A can touch the wafer W under a constant needle pressure. In consequence, highly reliable inspection can be carried out.

[0029]

If the diameter of the wafer W and the number of pins of the probe card 24 are increased, and the main chuck 17 is tilted by the unbalanced load during the overdrive operation, the pressure sensor 31 can measure the unbalanced load, and the contact position of the probe 24A can be corrected according to the measured load and the load-distortion data of the main chuck 17. In consequence, the position of the main chuck can three-dimensionally be corrected with high accuracy without being influenced by deformation that is attributable to heat effect from the probe card 24 or use. As shown in FIG. 5(b), the probe 24A can be securely brought into electrical contact with the electrode pad P of each chip in any spot on the wafer W, so that high-reliability inspection can be carried out securely.

[0030]

FIGS. 6 and 7 show another embodiment of the present invention. According to the present embodiment, as shown in FIG. 6, a support arm 32 extends horizontally from a straight trunk portion of a main chuck 17. The arm 32 is provided with a polishing mechanism 33 for polishing a probe 24A. The mechanism 33 includes a polish plate 33A for polishing the probe 24A and a support block 33B for supporting the polish plate 33A. The polishing mechanism 33 overdrives the polish plate 33A to polish the probe 24A. A pressure sensor 31A such as load cell is located between the support arm 32 and the support block 33B. The sensor 31A measures load that is applied to the polish plate 33A for the overdrive level. The relation between the measured load and a distortion of the polishing mechanism 33, like the load-distortion data of the main chuck 17, is measured in advance and loaded as load-distortion data of the polishing mechanism 33 in second storage means 132, separately from the load-distortion data of the main chuck 17.

[0031]

As shown in FIG. 7, a controller 13 according to the present embodiment comprises, the first spring constant calculating means 133B which obtains a spring constant KP of the probe 24A based on the load measured by means of the pressure sensor 31A, the second spring constant calculating means 133C which obtains a spring constant KC of the chuck 17 based on the relation between the load and distortion of the main chuck 17, the generated load

calculating means 133D which obtains a generated load GC in the position of contact between the probe 24A and the main chuck 17 based on the relation between the spring constant KP of the probe 24, the spring constant KC of the main chuck 17, and an overdrive OD of the main chuck 17. Based on the measured load from the pressure sensor 31A and the load-distortion data of the polishing mechanism 33, as mentioned before, the controller 13 can obtain a generated load of the main chuck 17 during inspection with high accuracy.

[0032]

More specifically, the polish plate 33A is brought into contact with the probe 24A when a given overdrive (X) is attained. The pressure sensor 31A measures a load (G) at that time. An overdrive that then affects the probe 24A is obtained as (B - X) from the relation between the aforesaid overdrive (X) and a distortion (B) for the load (G) of the load-distortion data of the polishing mechanism 33 loaded in the second storage means 132. Further, the first spring constant calculating means 133B obtains the spring constant KP of the probe 24A according to Equation (1) as follows:

$$KP = G/(B - X) \qquad \cdots (1)$$

The second spring constant calculating means 133C obtains the spring constant KC of the main chuck 17 from the relation between load-distortion data loaded in a main chuck information storage unit. Assuming an overdrive on the probe 24A is ODP and an overdrive on the main chuck 17 is ODC, the generated load calculating means D obtains the overdrive OD of the main chuck 17 according to Equation (2), and the then

generated load GC can be obtained according to Equation (3) as follows:

$$OD = ODP + ODC, \quad \cdots (2)$$

$$GC = KP*ODP = KC*ODC \quad \cdots (3)$$

[0033]

As seen from Equations (2) and (3), the overdrive OD and the generated load GC on the main chuck 17 have the relation given by Equation (4) as follows, where the spring constants KP and KC are known amounts:

$$GC = [(KP*KC)/(KP + KC)]*OD \quad \cdots (4)$$

By storing Equation (4) in a main chuck information storage unit 132A of the controller 13, during the inspection of the wafer W, as mentioned before, a CPU 133 can obtain the generated load GC on the main chuck 17 from the overdrive OD of the chuck 17, and besides, the load GC generated according to the overdrive OD for each moment can be monitored in order. Steady inspection can be securely carried out by controlling the overdrive to be constant in accordance with the generated load GC.

[0034]

If a probe card 24 is deformed with time, according to the present embodiment, a load reflective of the deformation of the probe card 24 can be monitored even during the inspection of the wafer W, since the generated load GC that reflects the deformation is measured by the polish plate 33A. Probe cards 24 of the same type are distorted somewhat differently, and in the strict sense, cannot be guaranteed exactly the same shape having a unique aspect. Even in this

case, the load GC generated from the probe 24A that is applied to the polish plate 33A in the polishing mechanism 33 is measured, so that the load on the main chuck 17 that is reflective of the individuality of each probe card 24 can be monitored.

[0035]

If an unbalanced load is applied to the main chuck 17 during the inspection of the wafer W, according to the present embodiment, the load on the chuck 17 can be monitored in the aforesaid manner. Thus, a distortion of the main chuck 17 can be accurately obtained, similar to the embodiment described above, the accuracy of three-dimensional correction of the probe 24A can be improved, and the probe 24A can be securely brought into contact with an electrode pad P. In consequence, functions and effects similar to those of the foregoing embodiment can be enjoyed.

[0036]

The present invention is not limited to the embodiments described above. According to the above description, the pressure sensor 31 is located, for instance, between the main chuck 17 and the X-stage 18. However, the pressure sensor may be set in any place that allows the load on the chuck 17 to be measured. The same applies to the pressure sensor provided on the polishing mechanism. After all, the probing method and the probing apparatus of the present invention comprehend any of probing methods and probing apparatuses in which load (needle pressure) from a probe that is applied to a main chuck is monitored during the inspection of wafers W, the overdrive

of the main chuck is controlled in accordance with the monitored load, and the position of contact of the probe is corrected three-dimensionally.

[0037]

[Advantage of the Invention]

According to the present invention described in claim 1 through claim 6, the probe can be brought accurately into contact with the electrode pad of the object of inspection even if the probe card is deformed from various causes or expanded or contracted by any thermal effect. If the main chuck is tilted by an unbalanced load during overdrive operation, moreover, the probe can accurately touch the electrode pad of the object of inspection, so that high-accuracy inspection can be enjoyed.

[Brief Description of the Drawings]

[FIG. 1]

A side view showing the principal part of one embodiment of a probing apparatus according to the present invention.

[FIG. 2]

A block diagram showing the principal part of the probing apparatus shown in FIG. 1.

[FIG. 3]

A view illustrating the operation of the principal part of the probing apparatus shown in FIG. 2.

[FIG. 4]

A diagram for illustrating the operation of a wafer on a main chuck shown in FIG. 2 and a probe.

[FIG. 5]

Illustration of the operation of the wafer and the probe shown in FIG. 4, in which FIG. 5(a) is a diagram for illustrating the respective behaviors of the wafer and the probe, and FIG. 5(b) is a diagram for illustrating the trace of the tip of the probe on an electrode pad.

[FIG. 6]

A side view corresponding to FIG. 1, showing another embodiment of the probing apparatus according to the invention.

[FIG. 7]

A block diagram showing the principal part of the probing apparatus shown in FIG. 7.

[FIG. 8]

A cutaway perspective view of a probing apparatus.

[FIG. 9]

FIG. 9(a) is a partially enlarged conceptual diagram showing the relation between a main chuck and a probe established when the main chuck is overdriven using a single-pin probe card by means of the conventional probing method. FIG. 9(b) is a diagram for illustrating the relation between an electrode pad and the trace of the tip of the probe in the state shown in FIG. 9(a).

[FIG. 10]

FIG. 10(a) is a partially enlarged conceptual diagram showing the relation between the main chuck and the probe established when the main chuck is overdriven using a multi-pin probe card by means of the conventional probing method.

FIG. 10(b) is a diagram for illustrating the relation between the electrode pad and the trace of the tip of the probe in the state shown in FIG. 10(a).

[Explanation of Reference Symbols]

10 … Probing apparatus,

13 … Controller,

17 … Main chuck,

24 … Probe card,

24A … Probe,

31, 31A … Pressure sensor,

33 … Polishing mechanism,

33A … Polish plate,

133A … Distortion processing means,

133B … First spring constant calculating means,

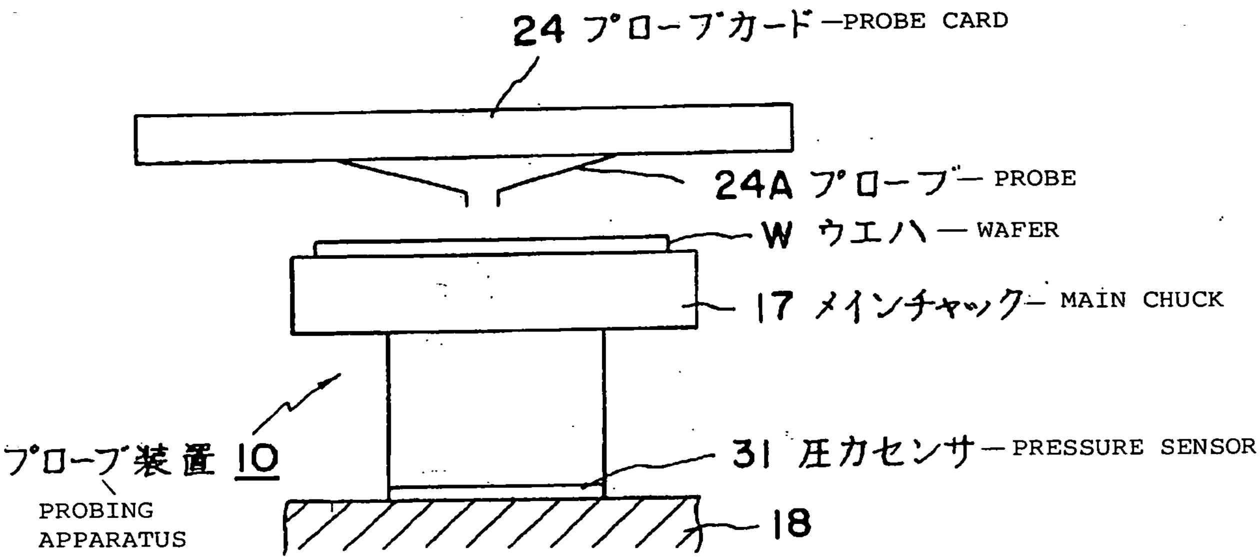
133C … Second spring constant calculating means,

133D … Generated load calculating means,

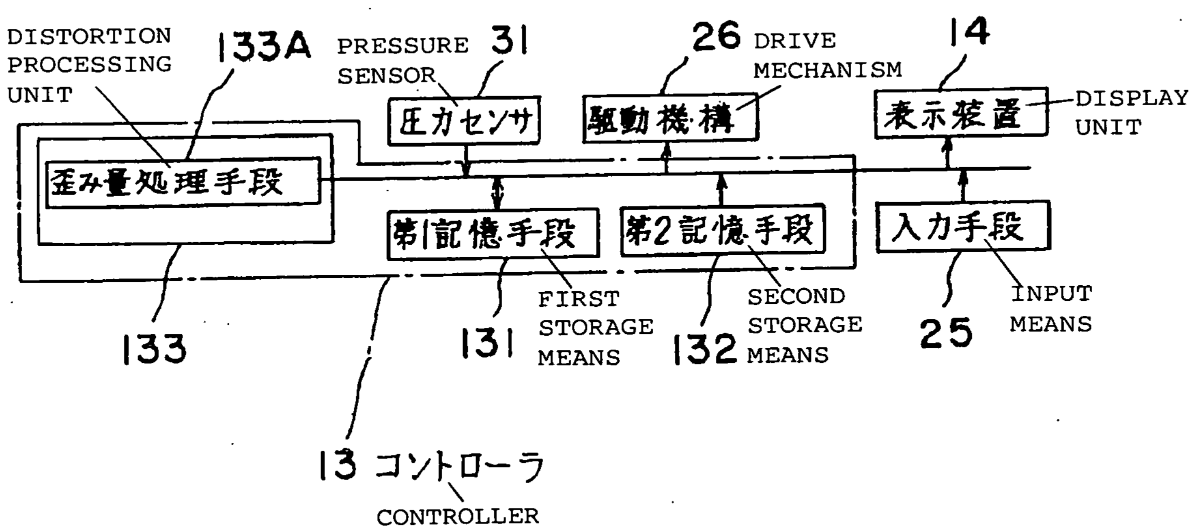
W … Wafer (Object of inspection).

【書類名】図面
[NAME OF DOCUMENT] DRAWINGS

【図1】
[FIG. 1]

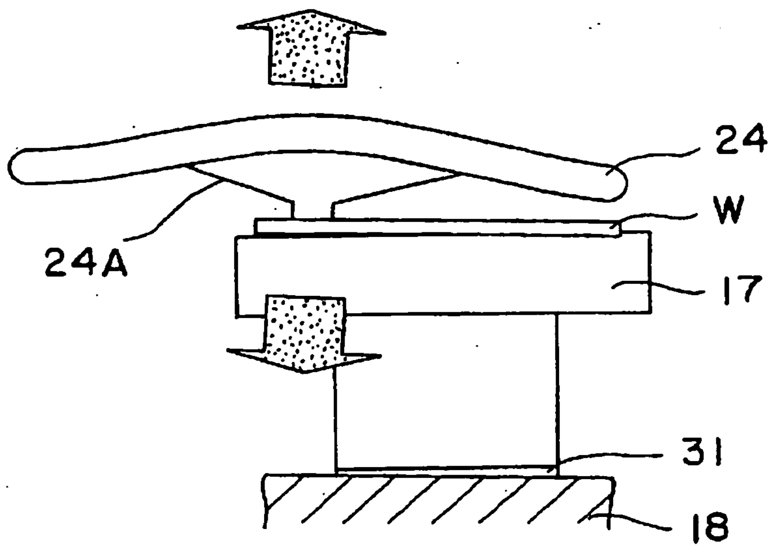


【図2】
[FIG. 2]



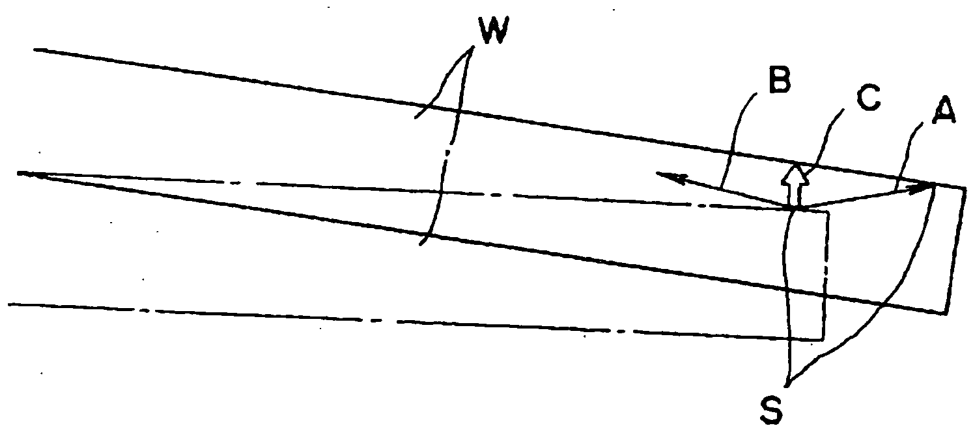
【図３】

[FIG. 3]

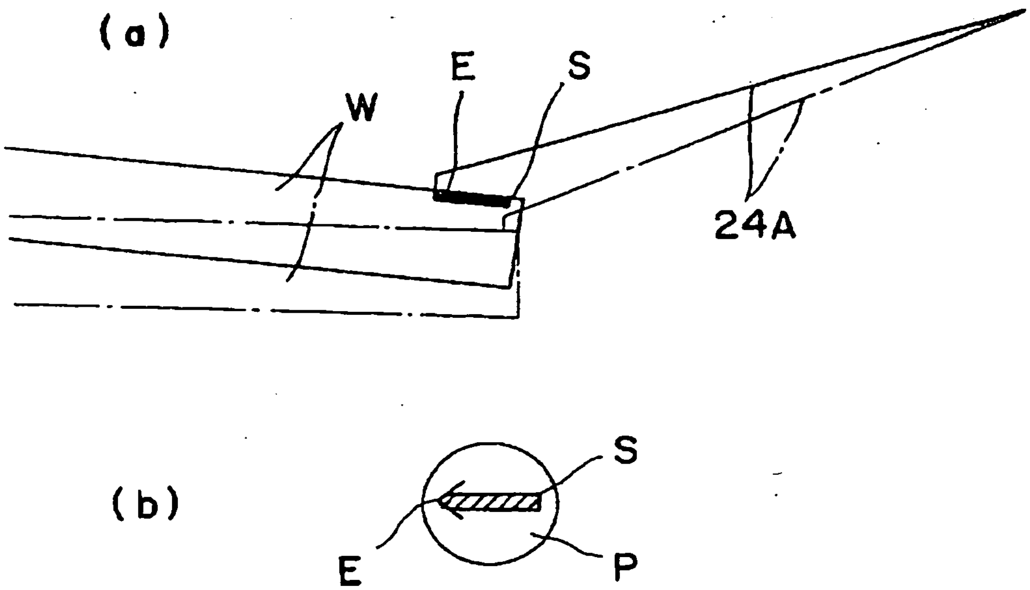


【図４】

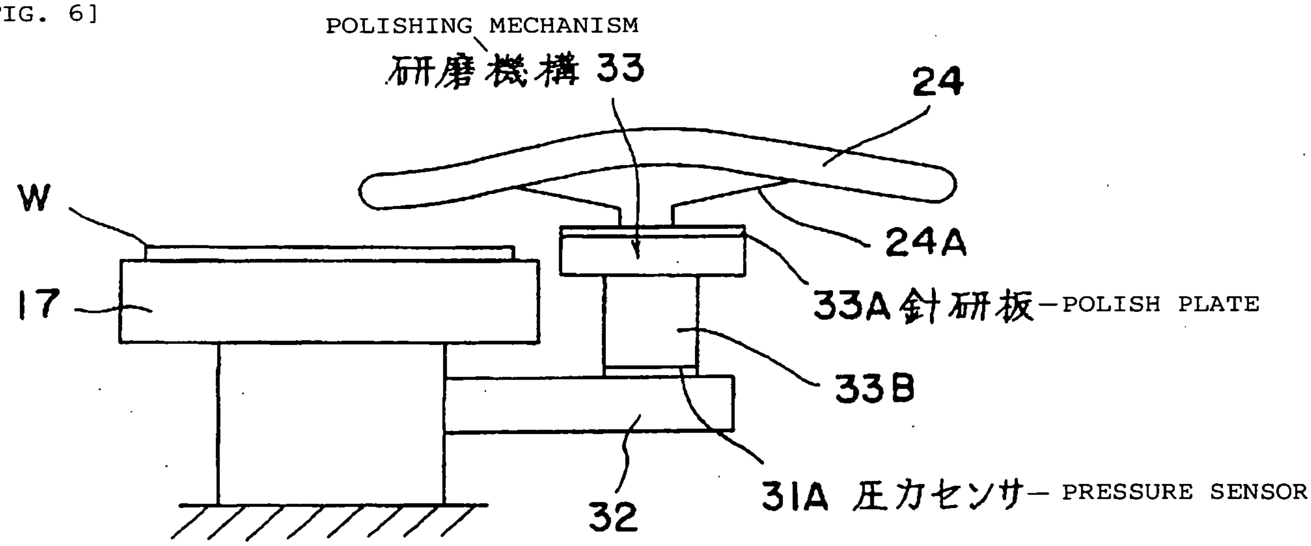
[FIG. 4]



【図５】
[FIG. 5]

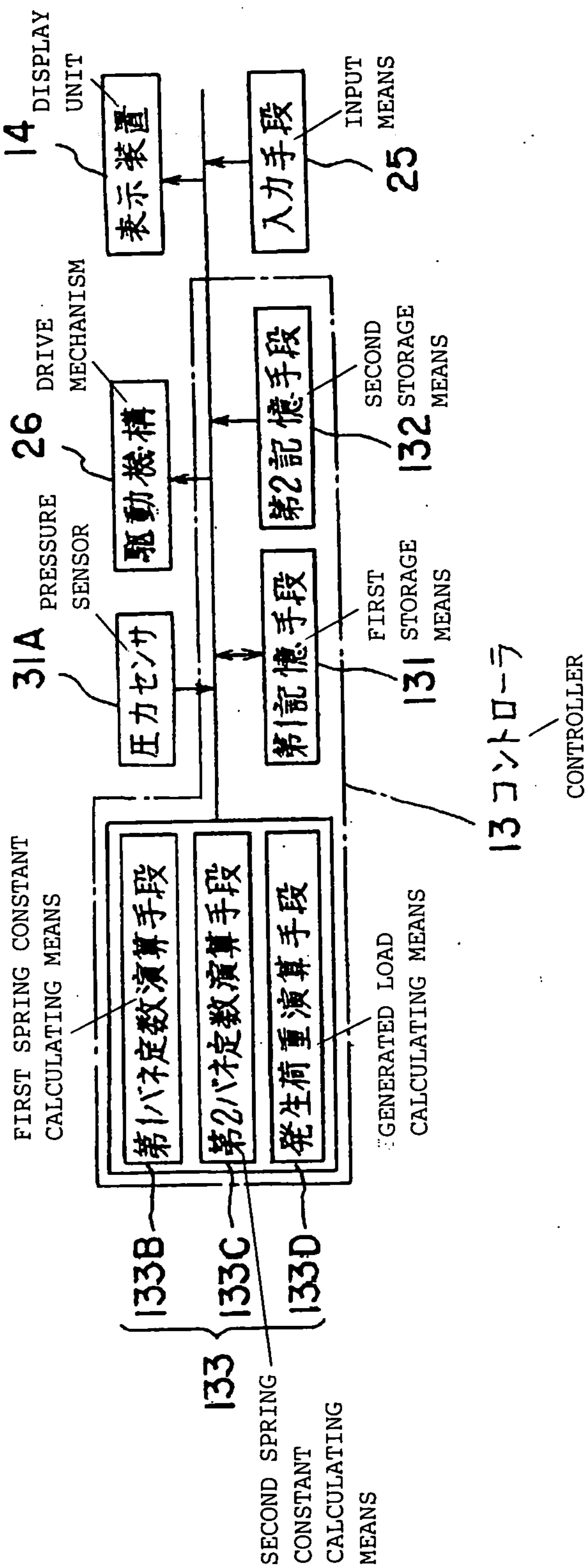


【図６】
[FIG. 6]



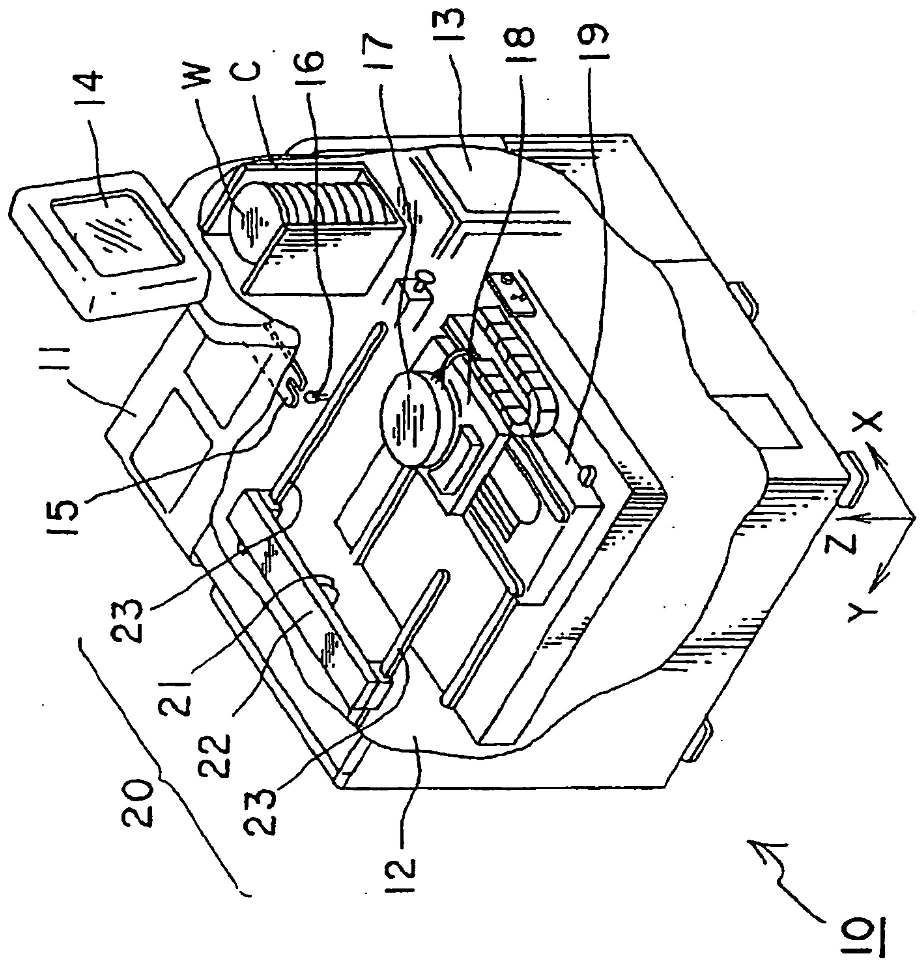
【図7】

[FIG. 7]

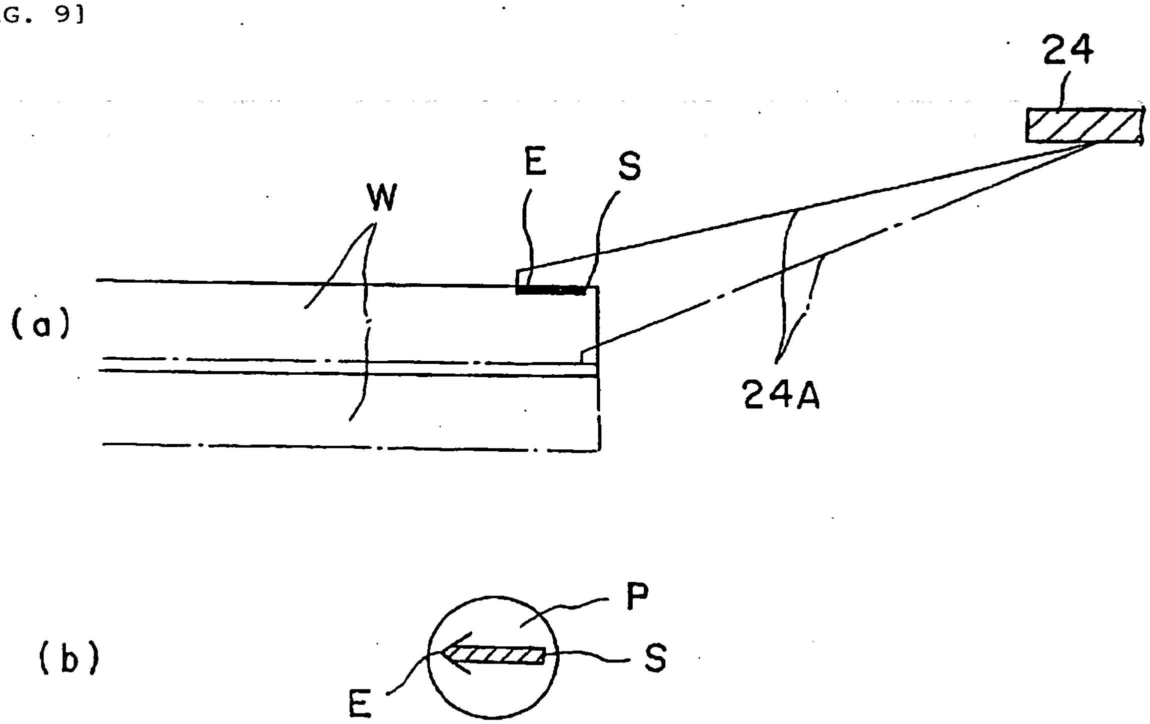

14 表示装置
DISPLAY UNIT
25 入力手段
INPUT MEANS
26 駆動機構
DRIVE MECHANISM
31A 圧力センサ
PRESSURE SENSOR
131 第1記憶手段
FIRST STORAGE MEANS
132 第2記憶手段
SECOND STORAGE MEANS
13 コントローラ
CONTROLLER
133B 第1バネ定数演算手段
FIRST SPRING CONSTANT CALCULATING MEANS
133C 第2バネ定数演算手段
SECOND SPRING CONSTANT CALCULATING MEANS
133D 発生荷重演算手段
GENERATED LOAD CALCULATING MEANS
133

【図8】

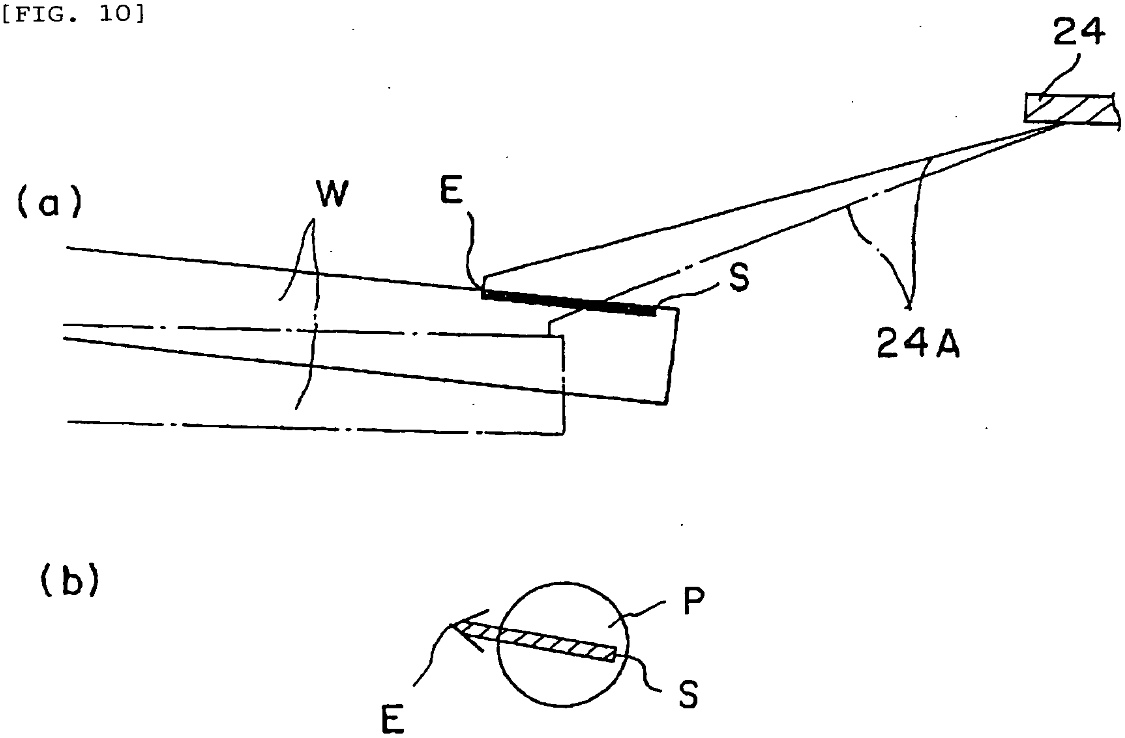
[FIG. 8]



【図９】
[FIG. 9]



【図１０】
[FIG. 10]



[Document] ABSTRACT

[Abstract]

[Object] Conventionally, a given overdrive is obtained based on driving level of the Z-axis. Therefore, even if the distance between the probe tip and the wafer W changes due to deformation of the probe card 24 with time or thermal expansion or contraction of the card during inspection, since the overdrive of the main chuck 17 is fixed, a constant contact load cannot be obtained.

[Means for Achieving the Object] According to the present invention, there is provided a probing method, which, under the control of a controller 13, brings a wafer W on a main chuck 17 into contact with probes 24A, and overdrives the main chuck 17 to inspect electrical properties of the wafer W, characterized by comprising: under the control of the controller 13, measuring, by means of a pressure sensor 31 provided with the main chuck 17, a load generated by contact of the probes 24A with the wafer during overdrive operation; and controlling an overdrive of the main chuck 17 on the basis of the measured load.

[Elected Figure] FIG. 1

APPLICANT'S PAST DATA

Identification Number	[000219967]
1. Date of Change	September 5, 1994
[Reason for Change]	Change of Address
Address:	5-3-6, Akasaka, Minato-ku, Tokyo,
Name:	TOKYO ELECTRON LIMITED